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ABSTRACT

Piagetian levels of 126 volunteers (60 males and 66 females) were measured using the Burney Logical Reasoning Test. Findings demonstrated that the six predictor variables succeeded in explaining 58% (pooled male/female sample), 53% (female sample), and 59% (male sample) of the variance in Piagetian cognitive levels. In addition, since prediction equations developed separately for each sex appeared to be different, the possibility of predicting Piagetian levels separately for males and females was suggested. (Author/SK)

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"Predicting Piagetian Cognitive Levels of Teacher Education Students at The Pennsylvania State University"

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INTRODUCTION

Extensive review of the literature reveals that few studies have reported results with regard to the question of predicting the Piagetian cognitive levels of the students in colleges and schools. Only the studies of Schindeler (1976), Ehindero (1977), and Moretti (1977) have been addressed to this question. Ehindero (1977) referred to the importance of predicting the Piagetian cognitive levels and determining the best predictor variables of these levels. He stated:

> . . . once these factors (the predictor variables) are known, then efforts being made by science educators to promote the architechtonics of formal operations in their students can be also applied towards promoting those desired and identified manipulable predictor variables (p. 25).

But the pioneer work of Schindeler (1976), Ehindero (1977) and Moretti (1977) may need to be continued. Each of these studies has indicated that its findings are tentative with a recommendation for further investigations. Moreover, these studies show mixed results with regard to the role of some variables used to predict Piagetian cognitive levels, namely, the role of verbal and mathematical aptitudes, high school grade point average and some others.

In addition those studies reported that their prediction of the Piagetian cognitive levels may be considered moderate and more can be done to improve this prediction in future studies.

STATEMENT OF THE PROBLEM

This study was mainly concerned with the prediction of the Piagetian cognitive levels; the criterion variable, of the teacher education students as measured by the Burney Logical Reasoning Test from a set of the following six independent variables, the predictor variables: (1) science achievement as measured by Sequential Test of Educational Progress - (Science Form IA); (2) sex; (3) high school grade point average; (4) verbal aptitude as measured by the verbal portion of the Scholastic Aptitude Test; (5) mathematical aptitude as measured by the

mathematical portion of the Scholastic Aptitude Test; and (6) field independent-field dependent cognitive style as measured by the Group Embedded Figures Test.

Specifically this investigation addressed itself to the fulfillment of the following objectives:

1) To determine the overall prediction efficiency of the six predictor variables to predict the Piagetian cognitive levels of the teacher education students as measured by the Burney Logical Reasoning Test.
2) To develop a prediction equation which may include a subset of the best predictor variables selected from the six predictor variables to maximize the prediction of Piagetian cognitive levels of the teacher education students as measured by the Burney Logical Reasoning Test.
3) To run cross-validation analyses to determine how much confidence may be placed in the prediction equation, when used in the future, to predict Piagetian cognitive levels of teacher education students as measured by the Burney Logical Reasoning Test.

Each of the above objectives was intended to be achieved for a pooled male and female sample and for each sex independently of selected teacher education students at The Pennsylvania State University.

METHODOLOGY

The Sample

The sample selected for this study consisted of 126 volunteers (60 males, 66 females) from the College of Education at The Pennsylvania State University during the Fall Term 1979 and Winter Term 1980. Their age ranged from 19 to 37 years with a mean age of 21.27 years and the standard deviation (SD) = 1.61 years.

Data Collection

Data obtained in this study was of two types; that which was indexed and that which was obtained through direct testing.

The indexed data were obtained from the students' records made available by the Office for Student Affairs, College of Education, The Pennsylvania State University. These indexed data included:

1) Sex
2) High School Grade Point Average
3) Scholastic Aptitude Test Verbal Score
4) Scholastic Aptitude Test Mathematical Score
5) Date of Birth

The first four of these data were used as measures of some predictor variables in the present studies, while the fifth, date of birth, was only used to report about the age of the sample.

The other types of data were obtained through administering three instruments; the Burney Logical Reasoning Test; the Sequential Test of Educational Progress (Science Form IA), and the Group Embedded Figures Test. Details about the construction of these three instruments, their validity and reliability can be found in Burney (1974), Handbook for Step Series II (1971) and Ottman et al. (1971) respectively.

Data Analysis

Mainly, two statistical techniques were utilized to treat the data: (1) Tukey jackknife for cross-validation technique (Mosteller and Tukey, 1977), (2) the Stepwise Multiple Regression Method (Kerlinger & Pedhazur, 1973).

The data related to pooled male and female sample, the male sample, and the female sample were analyzed in the following steps:

1) The Tukey jackknife for the cross-validation technique was executed by the JACKREG Computer program (Sagaria & Games 1978). This program was available at The Pennsylvania State University Computer Center. All the six predictor variables, were read into the program. Among the outputs of this program was the corrected R-square (R_c^2). This R_c^2 is known to be a good index of the prediction efficiency of the predictor variables (Sagaria et al. 1977).

2) The stepwise multiple regression method was executed by the SAS-STEPWISE Computer program available at The Pennsylvania State University Computer Center. This method results in selecting the best subset of variables to be included in the prediction equation.

3) The Tukey jackknife for cross-validation technique was utilized again to cross-validate the prediction equation. Not all of the six predictor variables were included in this cross-validation analysis. Only those variables selected by the stepwise method were read into the JACKREG Computer program. This program was available at The Pennsylvania State University Computer Center. Among the outputs of this program was the corrected cross-validation R-square (R_c^2C). This R_c^2C is considered the best estimate of the predictive validity of the prediction equation (Sagaria & Games, 1978).

RESULTS

The findings resulting from the above analyses of the data were:

1) The prediction efficiences of the total set of the six predictor variables as calculated by the corrected R-squares of the pooled male and female sample, the male sample and the female sample were 0.58, 0.53 and 0.59 respectively. These R-squares were also significant ($P<0.05$). In other words, the combined predictor variables succeeded significantly in predicting the Piagetian cognitive levels. These variables accounted for 58%, 53% and 59% of these levels in the pooled male and female sample, the male sample, and the female sample respectively.

2) A subset of the best predictor variables including science achievement (Sci-Ach), field independent-field dependent cognitive style (FI-FDCS) and verbal aptitude (Verb-Apt) was selected by the Stepwise method to be included in the prediction equation of the pooled male and female students and the female students repectively. However, this method selected only science achievement (Sci-Ach) and field independent-field dependent cognitive style (FI-FDSC) to be included in the prediction equation of the male students. Specifically, the prediction equations developed by the stepwise method at the probability of (<.05) were:

a. $\hat{y}$ = 1.88 + 0.128 (Sci-Ach) + 0.286(FI-FDSC) + 0.009 (Verb-Apt) for the pooled male and female sample

b. $\hat{y}$ = 2.96 + 0.1.50 (Sci-Ach) + 0.422 (FI-FDSC) for male sample

c. $\hat{y}$ = 1.63 + 0.141 (Sci-Ach) + 0.159 (FI-FDSC) + 0.011 (Verb-Apt) for female sample

3) The Predictive validities, as calculated by the corrected cross-validation R-square, of the prediction equations related to the pooled male and female sample the male sample and female sample were found to be 0.57, 0.54 and 0.55 respectively. These cross-validation R-squares were significant ($p < 0.05$).

DISCUSSION

The following were some conclusions drawn from the findings. (1) The present study seemed to achieve somewhat greater success over the investigations of Schindeler (1976), Ehindero (1977) and Moretti (1977) to predict the Piagetian cognitive levels. The six predictor variables used in this study could explain more than 50% of the variance in the Piagetian cognitive levels of teacher education students. Still, a considerable percentage in this variance could not be attributed to these variables. (2) The two prediction equations developed separately for the male and female teacher education students seemed to be different.

This difference could indicate that predicting the Piagetian Cognitive Levels of the two sexes was distinguishable. This indication was also shown by Moretti (1977). (3) Both the science achievement and field independent-field dependent cognitive styles seemed to be contributing factors in the cognitive development of the preservice teachers. Both variables were selected by the stepwise method as the best predictor variables related to the cognitive levels of those teachers. This selection could be expected. Many studies reported a high relationship between these two variables and the cognitive development (e.g., Ehindero, 1977; Lawson, 1980). (4) The three prediction equations developed in this study showed a reasonable predictive validity. However, some caution might be exercised if these equations are used in the future to predict the Piagetian cognitive levels. More studies are needed to investigate this predictive validity in large samples of teacher education students.

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ABSTRACT

This study was mainly concerned with the prediction of the Piagetian cognitive levels; the criterion variable, of teacher education students as measured by the Burney Logical Reasoning Test from a set of the following six predictor variables: (1) science achievement as measured by Sequential Test of Educational Progress (Science Form IA); (2) sex; (3) high school grade point average; (4) verbal aptitude as measured by the verbal portion of the Scholastic Aptitude Test; (5) mathematical aptitude as measured by the mathematical portion of the Scholastic Aptitude Test; and (6) field independent-field dependent cognitive style as measured by the Group Embedded Figures Test.

The sample selected for this study consisted of 126 volunteers (60 males and 66 females) from the College of Education at The Pennsylvania State University during the Fall Term 1979 and Winter Term 1980. Two statistical techniques were utilized to treat the data: (1) Tukey jackknife for cross-validation and (2) Stepwise Multiple regression. The study's finding demonstrated that: (1) the six predictor variables succeeded in predicting the Piagetian cognitive levels. They accounted for 58%, 53% and 59% of these level's variance in the pooled male and female sample, male sample and female sample respectively; (2) a subset of variables including science achievement, field independent-field dependent cognitive style and verbal aptitude was selected by the stepwise method to be included in the prediction equation of the pooled male and female sample and female sample respectively. However, this method selected only science achievement and field independent-field dependent cognitive styles to be included in the prediction equations of the male sample; (3) the predictive validities as calculated by the corrected cross-validation R-square (R^2_c) of the prediction equations developed for the pooled male and female samples and the male sample and female sample were found to be 0.57, 0.54 and 0.55 respectively.